May 1999

Treating People With Information: an Analysis and Review of Approaches to Communicating Health Risk Information

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Treating People With Information: an Analysis and Review of Approaches to Communicating Health Risk Information

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The communication of risk information is a fundamental aspect of nearly all health promotion interventions. However, no consensus exists regarding the most effective way to provide people with risk information. We will review and evaluate the relative merits of two approaches to risk communication. One approach relies on the presentation of numerical information regarding the probability of a health problem occurring, whereas the other relies on the presentation of information about the antecedents and consequences of a health problem. Because people have considerable difficulty understanding and using quantitative information, the effectiveness of interventions that rely solely on numerical probability information has been limited. Interventions that provide people with a broader informational context in which to think about a health problem have had greater success systematically influencing perceptions of personal risk but have several important limitations. However, before any final conclusions can be drawn regarding the relative merits of different communication strategies, investigators must agree on the specific criteria that should be used to identify an effective intervention. [Monogr Natl Cancer Inst 1999;25:44-51]

Because of the influence that perceptions of personal risk are thought to have on people's health practices *(1,2),* the communication of health risk information has become a prominent part of health prevention efforts. People are frequently provided with numerical information about the probability that a specific pattern of behavior (e.g., smoking) will lead to a particular health problem (e.g., lung cancer). Although the dissemination of this information has increased public awareness of potential health problems, its effect on perceptions of personal risk for these problems has been less dramatic *(3).*

Why has this information had such a limited effect on people's beliefs about their own personal vulnerability? A possible explanation is that people routinely misunderstand numerical information about the probability that an outcome will occur *(4).* This confusion leads people to misinterpret the implications of the information and, thus, undermines any systematic effect it might otherwise have on their beliefs and behavior. Moreover, people are not passive, unbiased processors of information about their health status (5). They welcome favorable information about their health but often engage in strategies that minimize or discount unfavorable health information—strategies that, in turn, blunt any influence this information might have on decision making and behavior [e.g., *(6-8)].*

In light of these cognitive and motivational barriers, what is the best way to communicate health risk information so that people both understand it and recognize its implications for their own risk status? We will examine several methods that have been used to communicate health risk information and evaluate their effect on perceptions of personal risk. Our goal is to identify conditions that maximize the desired impact of health risk information on people's health beliefs. The degree to which risk-based interventions affect people's behavioral practices is reviewed elsewhere in this volume *(see* Gerrard et al. [this monograph] and McCaul and Tulloch [this monograph]).

Before reviewing the merits of different approaches to risk communication, we consider two issues that are fundamental to any assessment of risk communication strategies. First, how do people think about and form judgments of health risks? Interventions designed to help people assess their risk will be successful only if consideration is given to how people process different types of health risk information. Second, what is the most appropriate way to assess the impact of a health risk intervention? An intervention could influence knowledge about a risk factor, beliefs about personal risk, perceptions of how one's own risk compares with the average person's risk, or intentions to act to reduce one's risk. Because these different measures can provide quite different impressions of people's beliefs, the specific set of criteria an investigator chooses to rely on can affect whether or not a particular intervention is perceived to be effective *(3,9).*

How Do People Think About Health Risks?

People are quite willing to provide estimates of personal health risks, but what these estimates reveal about their health beliefs is unclear. Although risk estimates are typically interpreted as the probability with which people believe a health problem will occur, there is considerable evidence that they reflect a broader set of cognitive and affective beliefs. Analyses of how people interpret and compare health risks have consistently revealed that lay perceptions of risk are not simply a function of probability information but rather are affected by the beliefs people hold about both the antecedents of the problem (for example: "Is it voluntary?" "Is it controllable?") and its consequences [for example: "Can it be detected?" "Would it be catastrophic?"; *see (10,11)].*

Why might people's perceptions of risk be affected by information about the antecedents and consequences of a health problem? First of all, people think about health problems in relation to their causes and consequences and, in fact, health information is organized in memory primarily around these two classes of information *(12).* Moreover, some investigators have proposed that people come to understand their risk on the basis of their ability to

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Published in *Journal of the National Cancer Institute Monographs*, No. 25 (1999), pp. 44-51.

mentally simulate or imagine themselves experiencing the problem *(13,14).* Thus, information will affect judgments of risk to the extent that it enables one to imagine that "it could happen to me." In the context of this framework, knowledge of both the antecedents and the consequences of a health problem has clear informational value.

Antecedent information helps people think about *how* a health problem could develop. It renders salient the specific factors that either promote or prevent the development of a health problem [e.g., *(15)].* Moreover, it helps people recognize the links between the very things that they do—or do not do— and unwanted health outcomes [e.g., *(16)].* Whereas information about the antecedents of a health problem underscores how people can alter their chances of developing a health problem, information about consequences emphasizes what it would be like to actually have the health problem. Vivid information about the consequences of the health problem helps people to recognize the severity of *what* could happen to them [e.g., *(17,18)]* and, moreover, that it actually has happened to people just like them [e.g., *(19)].* Thus, both types of information provide useful and nonoverlapping material to help individuals assess and interpret their risk.

Even though numerical probability information provides people with a precise description of their risk, its informational value is unclear. In and of itself, providing people with numerical probability information about a health problem (for example:
"You have a one in 500 chance of developing breast cancer") is likely to have little effect on their ability to imagine either *what* might happen to them or *how* it might occur. In fact, research has shown that people tend to underutilize probability information except when it provides explicit causal information about how a particular event will occur *(20,21).* Given that particular types of information about a health problem may have greater informational value than others, any evaluation of health risk communications must consider the characteristics of the specific information provided. In particular, messages that exclusively provide people with numerical probability information need to be differentiated from those that provide people with more general information about the antecedents or consequences of a health problem.

Evaluating The Impact of Health Risk Information

How does one determine whether a health risk message has been effective? Investigators have assessed people's knowledge of the specific risks posed by a behavior (for example: "How does smoking affect people's risk for lung cancer?"), beliefs about the absolute magnitude of their own risk (for example:
"Given your current smoking habit, what is your risk for developing lung cancer?"), and beliefs about how their risk compares with that of a specified comparison group (for example: "How does your risk for developing lung cancer compare with that of the typical smoker?").

Evidence that people are aware of the risks posed by a particular pattern of behavior may indicate the successful communication of health risk information, but it cannot tell us whether people recognize the risk as personally relevant. Direct measures of personal risk are needed to answer this question. However, it is not clear whether the criterion for an effective intervention should be based on changing absolute levels of personal risk or in modifying comparative risk. Numerous studies have revealed that people report their own risk of experiencing a health problem to be less than that of the average person and that this occurs even when they are given information about the average person's risk or behavior [e.g., *(22,23)].* This optimistic bias has been taken to indicate that people systematically underestimate important personal health risks and, thus, considered a barrier to the adoption of precautionary behaviors *[(24);* but *see (13)].* However, the absence of any empirical evidence that people's behavioral decisions are related differentially to perceptions of absolute and comparative risk limits any conclusion that can be drawn as to which measure offers the most informative assessment of people's beliefs.

Different Approaches to Communicating Health Risk Information

We now turn to a brief review of the literature on communicating health risk information. The review covers studies that have systematically compared different methods of communicating risk information, all of which were developed to affect people's beliefs about health risks that were associated with either their own behavior (e.g., smoking or sexual behavior) or their environment (e.g., radon). None of the studies included in this review addressed the communication of risks posed by different medical treatments.

We distinguish between two general approaches to communicating health risk information: a numerical probability-based approach and a contextualized approach. A probability-based approach focuses on the presentation of numerical information regarding the probability of a given risk occurring. The primary goal of studies that have utilized this approach has been to identify the most effective way to communicate risk information. Specifically, these studies seek to determine how different presentation formats affect people's ability to understand and, in some cases, use the numerical information provided. These interventions have ranged from the straightforward communication of a numerical probability (for example: "You have a one in 500 chance of developing cancer in the next 10 years") to presentation formats designed to heighten the salience or impact of the statistical information. Some of the more innovative presentation strategies have involved framing the information in terms of how frequently someone will die in a community as a result of a given risk *(25)* or presenting risk information in such a way that it can be compared with the magnitude of other risks *(26).*

A second approach to risk communication has focused on providing people with an informational context in which to understand and interpret their risk. The defining feature of a contextualized approach is that it provides people with information about the antecedents and/or the consequences of a potential health problem. A variety of intervention methods can be considered contextual. Some interventions have emphasized the antecedents of a health problem by providing people with specific information regarding the link between a health problem and their own prior behavior or medical history [e.g., *(16)].* Other interventions have used testimonials from people who have experienced the health problem to convey information about how the problem developed and/or how it has affected their lives [e.g., *(19,27,28)].* Other contextualized interventions have focused on providing people with information or images that render the negative consequences of the health risk salient and vivid [e.g., *(29,30)].* In almost every case, the primary goal of the intervention has been to increase people's recog-

nition of the risk posed by their behavior or environment. Thus, these interventions have been developed not only to communicate risk information, but also to do it in as persuasive a manner as possible.

There are several criteria that an investigator can use to determine the effectiveness of any given communication strategy. First, an effective strategy might lead people to be better informed about the likelihood of a health problem. Interventions that emphasize the presentation of probability information have focused primarily on this criterion. Alternatively, an effective strategy could appropriately alter people's perceptions of personal or comparative risk. Third, an effective strategy could be one that heightens people's interest in relevant primary prevention behaviors, independent of changes in risk perceptions. Empirical tests of contextually based interventions have focused primarily on the latter two criteria. Whenever possible, we report the effect an intervention method has had on both absolute and comparative measures of risk as well as whether changes in risk perceptions were associated with changes in other risk-relevant beliefs.

Impact of Probability-Based Approaches

When investigators provide numerical probability information, they rely on the premise that people will respond to a given probability in a consistent manner. That is, a 10% risk should be interpreted as a 10% risk, regardless of whether it is presented as a percentage or an odds ratio or whether it is presented numerically or pictorially. Unfortunately, empirical tests of probability-based communications have typically failed to support this premise [e.g., *(31,32)].* People have difficulty recalling probability information accurately [e.g., *(33,34)],* they make errors when asked to transform percentages into proportions or vice versa (e.g., Lipkus I: unpublished data [numeracy survey], 1998), and they confuse information about the frequency of a event with its rate of occurrence [e.g., *(35)].* Thus, it would appear that people cannot reliably understand and interpret numerical probability statistics.

In fact, there is direct evidence that people do not appreciate some of the fundamental assumptions underlying probabilities. For example. Black et al. *(36)* reported that a substantial number of women estimated that their risk of developing breast cancer was less than their risk of developing *and* dying from it. People also have difficulty understanding and estimating cumulative risks associated with repeated patterns of behavior [e.g., contraception use *(37,38)].* More broadly, Schwartz et al. *(39)* assessed people's familiarity with basic probability and numerical concepts (i.e., numeracy). They found not only that people's understanding of these mathematical concepts was quite poor, but also that their ability to accurately interpret numerical information regarding breast cancer and mammography was systematically dependent on their level of numeracy.

People's beliefs are also sensitive to the specific numbers used to illustrate a risk. For example, people may be more concerned about a potential health problem when they are told that a pattern of behavior will increase their risk of dying by 30% than if they are told that it will change their risk of dying from one in 10000 to 1.3 in 10000 *(11).*[1] Several studies have shown that people respond differentially to a ratio when it is expressed as 1:10 versus 10:100 and that this occurs even when they understand that the two ratios illustrate the same probability *(40,41).* Moreover, Yamagishi *(42)* found that people rated a health problem as riskier when they were informed that it kills 1286 of 10000 people (12.86%) compared with 24.14 of 100 people (24.14%). It would appear that people fail to consider the relevant sample size when processing information regarding the number of people who have developed or died from a health problem *[but see (31)].*

In addition to the difficulties people have with the mathematical properties of probabilities, investigators must grapple with the fact that people find it difficult to ascribe meaning to a given level of risk. What does it mean to be told that you have a 1 % chance of having a disabled child or that your risk of dying from cancer has increased from one in 10000 to 1.3 in 10000? Although these statistics may be extremely precise, people's responses to this information are anything but precise. When provided with numerical estimates, people appear to spontaneously transform the probability information into discrete categories [e.g., high or low risk *(43,44)].* To the extent that people make decisions based on the belief that their risk is either high or low, the specific numerical probabilities they provide may not be particularly reliable or informative. Consistent with this analysis, Windschitl and Wells *(45)* found that people's numerical probability estimates failed to predict their preferences and behavioral intentions, whereas the verbal labels they used to describe the likelihood of an outcome consistently predicted the same set of decisions.

Because people have difficulty ascribing meaning to a probability estimate, they are acutely sensitive to available comparison information. In fact, when asked what information would help them understand a health risk, individuals typically request comparisons between the probability of different risks *(46).* Evidence that people readily construe risks in a comparative frame comes from studies that have manipulated the comparison information provided. Klein *(47)* has shown that people's affective reactions to information about their risk depend on how their level of personal risk compares with the average risk, independent of their absolute level of personal risk. Studies that have presented risks along a continuum have shown that people's interpretation of the same numerical probability depended on whether it was placed at the high end or the low end of the continuum *(26).* People's interpretation of the implications of their behavior is similarly affected by whether a response format leads them to believe that the frequency of their behavior is above or below the perceived norm (Rothman AJ, Haddock G, Schwarz N: manuscript submitted for publication). Of course, the manner in which risk information is presented is but one source of information that can affect how people interpret or use a given probability. Research has shown that people's knowledge, personality, and goals can also influence their interpretation of what a particular risk means [e.g., *(48-50)].*

The primary appeal of health risk communications that present numerical probability information is that they offer people precise information regarding the probability that a health problem will occur. However, the effectiveness of this communication approach is constrained by people's inability to accurately interpret and use numerical probabilities. In fact, the very strategies that people employ to render probability information more useful strip it of the very precision that this intervention approach offers.

Impact of Contextualized Approaches

In light of the limitations of a probability-based approach to communicating risk information, we now consider an alternative method that provides people with information to assist them in understanding the personal implications of a given health risk. Recall that, although risk is typically defined as the numerical probability of a given event occurring, lay conceptions of risk are based on a much richer set of cognitive and affective beliefs. When a health problem is being considered, information about the numerical probability of a risk is viewed as insufficient;
people are interested in information about what causes a health problem, about the severity of its consequences, and about what can be done to either prevent or treat the problem *(51,52).* This information is considered valuable because it enables people to develop a mental model that delineates the personal relevance of a given risk—what might cause one to develop a health problem and the potential costs of developing that problem.

Antecedents. Interventions that heighten the salience of factors that place people at risk for adverse outcomes have typically involved directing their attention to relevant aspects of their behavior or personal attributes. For instance, Gerrard et al. *(53)* had female Marines review their sexual and contraceptive histories prior to assessing their risks for pregnancy and human immunodeficiency virus (HIV) infection. This behavioral review heightened judgments of personal risk for HIV infection and, in some cases, personal risk for pregnancy. Other interventions have provided individuals with personalized information about the link between a health problem and specific behavioral or personal characteristics. This strategy has been somewhat successful in rendering both optimistic and pessimistic misperceptions about comparative risk more accurate *(16),* although other investigators *(54)* have found that directing people's attention toward potential risk factors failed to reduce optimistic perceptions of comparative risk.

Some investigators have emphasized the need to differentiate between the absolute amount of risk-relevant information people can bring to mind and the relative ease with which that information is recalled. Traditionally, interventions have assumed that the more risk-increasing factors people bring to mind, the more at risk they will feel. However, the experienced ease with which information comes to mind has also been shown to systematically affect judgment [e.g., *(55)*]. Specifically, people who have easily brought a few risk-increasing factors to mind may infer a greater degree of personal risk than do people who had difficulty bringing to mind a larger number of risk factors. Both Rothman and Schwarz *(15)* and Raghubir and Menon *(56)* have successfully used this approach to heighten perceptions of personal risk, although only Raghubir and Menon obtained a reduction in participants' optimistic perceptions of comparative risk.[2] Perceptions of personal risk are also sensitive to the relative ease or difficulty with which risk-decreasing factors come to mind. In this case, having had difficulty generating a large number of risk-decreasing factors can lead to increased perceptions of personal risk *(15).*

Consequences. Investigators have developed two different strategies to increase the salience of outcomes associated with a given health problem. In each case, the goal of the intervention has been to increase the personal relevance of the risk by helping people to recognize that the health problem could happen to them. Sherman et al. *(57)* provided people with a set of symptoms that were either easy or difficult to bring to mind and observed that the ease with which people could imagine themselves experiencing the symptoms of a disease heightened their perceptions of personal vulnerability. More recently, interventions have tried to emphasize the personal relevance of a health problem by highlighting the similarities between members of the targeted audience and people who have had personal experience with a health problem. For example, the presentation of personal testimonials by HIV-positive individuals has led to increased perceptions of personal risk—but only when people perceived themselves to be similar to the person providing the testimony [e.g., *(27,28); see also (58)]*. In fact, Gump and Kulik *(28)* have demonstrated that the level of personal risk people will recognize depends on the degree to which they are able to see themselves as different from the infected person.

A second approach to highlighting the outcomes associated with a given risk has involved messages that graphically illustrate the severity of the consequences associated with a health problem *[(8,18); see* Salovey et al. *(1)* for a recent review]. For example, Sutton and Hallett *(30)* successfully raised perceptions of personal risk related to seat belt use by showing people graphic scenes of car crashes and mortuaries. Similar effects have been found for images that depict outcomes related to cigarette smoking [e.g., *(29,59)]*. Although there is no empirical support for the premise that the disturbing nature of these appeals would lead people to minimize the personal relevance of a given health threat, people must know how they can respond to the health threat if a fear appeal is going to elicit a change in behavior *(18,60).*

Given the findings obtained across a range of experimental paradigms, it would appear that interventions that render either the antecedents or the consequences of a health problem salient can have a meaningful effect on perceptions of personal risk. Although people may be responsive to information about what could happen to them and how it might occur, the specific processes by which this information affects risk beliefs have yet to be well specified. We consider this issue as well as potential limitations to this communication strategy in the following section.

What Have We Learned and What Do We Still Need to Know?

On the basis of the empirical research covered in our review, we believe that several conclusions can be drawn regarding the communication of health risk information. First, people do not respond in a consistent manner to communication strategies that rely solely on the presentation of numerical risk information. From the perspective of an expert, the precision afforded by a numerical probability estimate may be appealing, but its influence on lay people's beliefs and behavior is anything but precise. Any systematic impact that this information might have on decision making and behavior is undermined by people's inability to understand the meaning of a specific probability and their resulting computational errors. In an attempt to ascribe meaning to a given risk, people's inferences are strongly affected by information that is accessible at the time of judgment. Thus, there is considerable variability in how people respond to probability-based risk messages.[3] Interventions that provide people with information about the causes or consequences of a particular health problem appear to have a more consistent influence on perceptions of personal risk precisely because they systematically control the information people have available when drawing inferences about their personal

risk. Moreover, the observation that contextually based approaches to providing risk information are more effective is consistent with the broader finding that people are more likely to base their judgment on concrete, case-based information than on abstract, statistical information [e.g., *(63,64)]*.

Recognizing the Limitations of a Contextually Based Communication Strategy

Although interventions that have utilized a contextually based approach to communicating risk information have had some success affecting perceptions of personal risk, investigators cannot assume that people will always respond appropriately to the health information provided. Because people want to maintain a favorable impression of their health status, they may, if possible, selectively attend to information about their health. For example, when asked to consider how their own risk for a health problem compares with that of the average person, people selectively bring to mind health practices that make them look good *(65)*. In a similar manner, people have a better memory for behavioral guidelines that place their behavior in a favorable (healthy) light than for those that place it in an unfavorable (unhealthy) light *(66)*. Finally, when asked to consider their own behavioral practices, people may selectively focus on the preventive actions that they have adopted rather than on the risks that they have taken *[(53,67);* for a complete discussion of these findings, *see* Gerrard et al., this monograph].

Even when people do attend to information about potential health risks, they may search for flaws in the message or adopt higher standards for evaluating the quality of the information *(6,8,68)*. In situations where risk information cannot be refuted directly, people may adjust other beliefs in an attempt to counter the undesirable implications of the risk message *(7,69,70)*. For example, Gerrard et al. *(7)* observed that, even though young adults increased their perceptions of risk in response to an increase in their risk behaviors, they also increased their assessment of the prevalence of these behaviors (thereby normalizing the practice) and decided that the health implications of these behaviors were less relevant to future behavioral decisions.

However, the importance of people's attempts to minimize the implications of the risk information is unclear. Several studies have observed that, even when people act to minimize a health threat, they remain interested in information about how to address the problem [e.g., *(71-73)]*. For example, people who learned that they had borderline high cholesterol perceived high cholesterol to be a less serious health problem than did those who were told that they had low cholesterol, but they still expressed greater interest in taking steps to lower their cholesterol *(72)*. There is even evidence that interventions can prompt changes in behavioral intentions independent of observed changes in risk perceptions. Gump and Kulik *(28)* found that the HIV status of a man describing his experiences influenced intentions to be HIV tested independent of changes in perceptions of personal risk. Similarly, Evers et al. *(27)* found that heterosexuals reported stronger intentions to be HIV tested regardless of the sexual orientation of an HIV-positive speaker, whereas they changed their perceptions of personal risk only after having listened to a heterosexual speaker.

The observed dissociation between people's risk beliefs and their behavioral intentions should not be interpreted as a sign that changes in people's behavior can be elicited in the absence of information about health risks. Information about a potential health risk may be necessary to initiate the self-regulatory processes that underlie an appropriate behavioral response. However, people may independently regulate their affective and behavioral responses to a health threat, as suggested by Leventhal's Parallel Response Model *(12,18)*. Specifically, people may choose to respond both in ways that alleviate their distress about a potential health problem (thereby attenuating any change in perceived risk) and in ways that serve to reduce the likelihood that they might develop the health problem (thereby eliciting changes in behavior). It is precisely because people may respond to health risk information in myriad ways that investigators who test interventions must attend not only to changes in people's perceptions of the chance of a health risk occurring, but also to changes in people's beliefs about the implications of that risk and how they intend to respond to that risk. In the absence of an assessment of these ancillary beliefs, it may be difficult to draw conclusions regarding the practical significance of any observed change (or lack thereof) in perceived risk.

Moving Beyond the Perceived Magnitude of One's Risk

At present, health risk interventions are primarily evaluated on the basis of their ability to influence perceptions of risk. Although the possibility that behavioral intentions will change independent of any change in perceived risk indicates that investigators need to employ a broad array of indicators when evaluating an intervention, consideration should also be given to the specific manner in which changes in perceived risk are assessed. In fact, the apparent dissociation between risk beliefs and behavioral intentions may reflect, in part, the ways that investigators have operationalized perceived risk. Almost all measures of risk perception have been designed to detect changes in the perceived likelihood of a person's risk. However, what if an intervention is effective not because it leads people to believe something is more likely to happen but instead because it causes them to be more concerned about a given risk? For example, a person might still report a 1 % risk of developing a health problem but be considerably more concerned about that level of risk. Current measures of risk perceptions are not able to detect changes in the meaning people ascribe to a specific level of risk. The inclusion of measures of worry and concern about a health risk might help address this problem. In fact, McCaul et al. *(74)* have found that how worried a woman was about developing breast cancer predicted mammography screening utilization even after controlling for her perception of personal risk. It might also be useful to assess whether an intervention has altered the salience or accessibility of a person's risk perceptions. Interventions might prove to be effective not because they increase people's perceptions of risk but because they increase the probability that beliefs about personal risk will come to mind when people are faced with a behavioral decision.

Toward a Model of Health Risk Communication

Despite the fact that investigators have assessed the merits of a range of risk communication strategies, our limited understanding of how different aspects of a health risk message affect people's beliefs and behaviors constrains any recommendations that can be formulated. The observation that information regarding both the antecedents and consequences of a health problem can reliably affect people's risk beliefs may offer a base on which a conceptual model of risk communication can be built. Information about

the antecedents and consequences of a health problem is believed to be effective because it enables people to imagine that "it could happen to them" *(13,14)*. Information about the consequences of a health problem helps people to recognize what could happen to them, whereas information about the antecedents of a health problem helps people to understand how it could happen. Because people rely on these two dimensions (i.e., cause and consequences) to structure their mental models of health problems *(12),* information about the antecedents and consequences of a health problem has considerable informational value and can be readily utilized.

When people receive information about the consequences of a health problem, the implications of a potential health risk are rendered vivid and concrete. Although people may more readily recognize the severity of a potential health problem and may even be motivated to take precautionary action, imagining what it would be like to have a health problem does not provide people with sufficient information about how to address the potential problem. In the absence of information about how to effectively deal with a health problem, information about consequences may elicit greater feelings of personal risk and concern but, at the same time, may cause people to feel less confident about their ability to deal with a potential health threat. Because people need to know what they want to avoid and how they can go about minimizing their risk, merely drawing people's attention to the undesired consequences of a health problem is not likely to be an effective way to elicit risk-reducing behavior *(18,75)*.

Information about the antecedents of a health problem directs people's attention toward the factors that determine whether or not the problem will develop. Because antecedent information informs people about the specific factors that cause one's risk to increase, it can simultaneously provide them with information about what, if anything, they can do to minimize their risk. Thus, antecedent-based risk interventions offer the possibility of increasing not only people's perceptions of personal risk but also their confidence that they can cope with a potential health threat *(18,75)*. However, in and of itself, information about what causes a health problem to develop provides people with little information regarding the severity of the potential problem. People may learn how to minimize their risk, but in the absence of information about the severity of the problem they may not be sufficiently motivated to take action. Given that information about the consequences of a health problem provides people with a clear reason for taking action, the integration of information about the antecedents and the consequences of a health problem may prove to be an effective way to maximize the impact of a health risk intervention. Studies are needed that systematically examine the effect that the proposed integrative framework has on people's affective and behavioral responses to a health risk communication, with specific attention paid to the factors that are thought to mediate the impact of each type of information.

The development of a more precise understanding of how people respond to a health risk message should also help investigators anticipate *a priori* what factors are likely to moderate the message's impact. Given the heterogeneity of the health risks people must deal with, it is unlikely that a single intervention approach will prove effective for all health problems. Only with the formulation of a conceptual model of risk communication will we be in a position to predict whether an effective intervention strategy can be transferred successfully from one health domain to another. In a similar manner, even though studies have revealed that individual differences in personality and in prior experience can influence how people process health risk information [e.g, *(15,49)},* the extent to which these moderating factors generalize across health domains or interact with other aspects of the intervention strategy is not yet known (but *see* Gerrard et al., this monograph).

Can the Informational Value of Probability Information Be Increased?

Contextually based interventions have proven capable of influencing perceptions of risk, but these methodologies lack the precision afforded by a numerical estimate of the probability that an event will occur. Could an intervention integrate the presentation of probability information with information about the causes and consequences of a health problem? This approach would offer people precise information about the magnitude of their risk, but it would do so in a context that clarifies the implications of this information for their health. However, any intervention strategy that depends on the precision afforded by numerical probability information must confront the difficulties people have when forced to use this information *(39)*. If interventions are going to rely on people's ability to use probability information, then investigators need to provide them with the skills required to use the information accurately and appropriately. People need to know not only how to interpret numerical information about a specific health risk, but also how to gauge the degree to which adopting a particular precautionary behavior will affect these probabilities. Although there is considerable evidence that people can be taught to use basic statistical principles [e.g., (76,77)], the feasibility of integrating basic lessons in numeracy into interventions that provide people with health risk information remains untested.

Final Thoughts

If we expect people to make informed decisions about their health, information must be communicated to them in a manner that they can understand and use. Although scientific advances continue to provide increasingly more precise information about the health risks that people face, there has been little consensus as to the most effective way to communicate this information. On the basis of our review of the literature, we believe that intervention approaches that help people understand how a health problem could develop (i.e., its antecedents) and recognize what could happen to them (i.e., its consequences) offer the most effective way to communicate health risk information. However, the strength of this assessment is tempered by the absence of studies that have systematically compared the merits of different intervention approaches. A new generation of intervention studies is needed that will allow investigators to assess directly the relative impact of different risk communication strategies. However, the identification of effective communication strategies is not sufficient. Investigators need to determine not only what strategies are effective but also why they are effective. Substantial progress in our ability to transfer successful interventions across both different health domains and different participant populations will come only after we have developed a more precise understanding of how people process and utilize health risk information.

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Notes

[1] Although this observation is frequently cited, no direct test of this claim could be identified. However, Halpern et al. *(31)* have found that people perceived oral contraceptives to pose a greater health risk when the information was presented as a relative risk (e.g., 415% greater risk of dying) than when it was presented as a base rate (e.g., one in 12,000 die).

[2] Although people primarily rely on the ease with which information comes to mind, they will base their judgment on the specific content of the recalled information when they are motivated to process the information in a more systematic and detailed manner *(15)* or when their subjective experience has been rendered nondiagnostic *(55)*.

[3]0f course, conflicting interpretations of information are not limited to numerical presentations of information. Several investigators have found there to be considerable variability in the values that people assign to quantitative labels such as frequently, sometimes, or occasionally [e.g., *(61,62)]*.

Portions of this manuscript were presented at the Cancer Risk Communication Workshop organized by the National Cancer Institute. We thank Rick Gibbons, Meg Gerrard, Steven Martino, and Neil Weinstein for their comments on an earlier version of this manuscript.